



Impact of Gamification and Incentivization on Green Behavior: An Analysis of Implementation of *Operation CO₂*, an Innovative Mobile Application for Reduction of Carbon Footprint

Ishanvi Shetty¹, Ananya Anand Iyer¹, Nitya Patni¹, Nikhil Pradhan¹

¹GEMS Modern Academy, Dubai (United Arab Emirates)

Abstract: *Operation CO₂* is an app designed to promote green behavior within individuals and communities. It encourages young adults and students to perform activities to reduce carbon footprint as consumers are mostly unaware of the carbon footprint in their daily lives. The purpose of this study is to motivate people to save the environment. The current study has been performed to analyze the impact of incentivization on green behavior, and to examine the propagation of the same using game mechanics and rewards. The research was conducted with students, young adults and their parents at a Dubai based school and using prior research in this area. People are encouraged to perform various environment friendly activities under 5 different categories: transportation, household changes, environment initiative participation, clean up drives, reduction in water and electricity consumption. This app tracks an individual's contribution towards reducing carbon footprinting. An empirical study based on the survey data supports the usage of this app.

Index Terms - Carbon Footprint, Gamification, Incentivization, Consumer Engagement, Rewards.

INTRODUCTION

The climate crisis is one of the biggest threats humanity has ever faced. Rise in temperature, change in weather patterns, melting of ice caps, can be very lethal to us as well as other living organisms on Earth. [World Economic Forum](#) has conducted research on the impact of carbon footprint on the environment and we can infer that the impact can be extremely severe. It explains that there exists in the world, equilibrium climate sensitivity which is required to be maintained between 1.5 °C and 4.5 °C, but due to the increase in temperatures on Earth and accumulation of CO₂, the temperature range is increasing and causing an imbalance in the function of the Earth's weather patterns. Yet even as this is a widely accepted fact, people refuse to make a change. The problem lies in the fact that though the crisis is a global issue which is affecting every single person, people believe that the power to make even a small change isn't in their hands. With government bodies and large, powerful entities and public figures making little to no positive change, and the general public having the mindset that they alone cannot make a difference, the threat of climate change is progressively getting worse than ever. The average individual person cannot be bothered trying to help in any way they can, especially since they think that the work they do won't help. Statistics have clearly proved otherwise, as the average person emits around 4 tons of carbon footprint every single year ([UCAR- Centre for Science and Education](#)), leading to the average emission of about 304 tons in a lifetime, considering the average life expectancy to be 76 years. Furthermore, people do not have any motivation or reason to perform these green behavior tasks as it does not result in any personal benefit for the individual. And even when people perform these activities, keeping track of them and rewarding them is a tedious manual process, There is some prior research which has been done in the area of using gamification and incentivization, including few in the area of green behavior, some of which have been referred here for the purpose of the study for gaining further insight and seeing how it applies when it comes to green behavior especially among students and young adults, and also in relation to the app *Operation CO₂*. There are some apps also which already use gamification for green behavior, some of which are Green Me!, Joule Bug, Eco-Dice and Recapp. Our initial research suggests that the development of a simple software allowing users to execute certain chores, log them in, and get rewarded for their actions, would prove a successful endeavor. As a result, the current study was carried out in order to analyze the impact of gamification and incentivization on green behavior propagation and to design and develop the application for students, environmental experts, and citizens concerned about the effects of greenhouse gas emissions. The software enables individuals to log in their daily green behavior-related activities, whilst motivating them to perform more of such activities or go the extra mile with the rewards, incentivization and gamification strategies implemented.

RESEARCH METHODOLOGY

3.1 Working of the App

Operation CO₂ aims to tackle the above issue of people's involvement in climate change by providing people who perform environmentally friendly tasks with rewards and recognition to do so. There are lists of tasks they can perform, and upload task-specific evidence for them. Performing these tasks lead to the earning of points (according to the tasks they do) that can later be redeemed for various rewards. Operation CO₂ includes a leaderboard, to include some healthy competition amongst people all over the organization/city/country. The authors aim to make the process of tracking and rewarding environment friendly activities easy by digitizing it. The app can be used by all, but we aim to focus more on the youth. The activity specific evidence uploading makes it easier and more appealing to log on to your activities, especially with the prospect of a reward. To show users how the app functions, a prototype was made using the website Thinkable. We intend to further develop the app using suitable development tools and offer on the market later. The app provides the following functionality. Firstly, to gain points, users need to complete eco-friendly tasks in any of the five categories listed in the app. Secondly, they have to maintain documentation or evidence to support their completion of the task. The user then logs in and uploads the same in the desired format on the app (Figure 1). The app will verify the evidence, or the uploading of the evidence will be in such a way that it will be self-verifying. The app will then calculate the points to be allotted for that particular activity, and finally based on the points the appropriate reward and/or recognition will be displayed.



Figure 1: Screen for uploading evidence of the activity.

The above screen shows a page where the users can upload evidence based on the activity (over here, the reduction of a water bill or maintenance of a low one). Users will be ranked on the leader board based on their points and based on where they rank on the leader board, they will receive their respective prizes. The leaderboard (Figure 2) is one of our vital features which serves as a medium to raise competition amongst our users and to develop the hunger to become better at managing household and life while adhering to the environmental conditions.

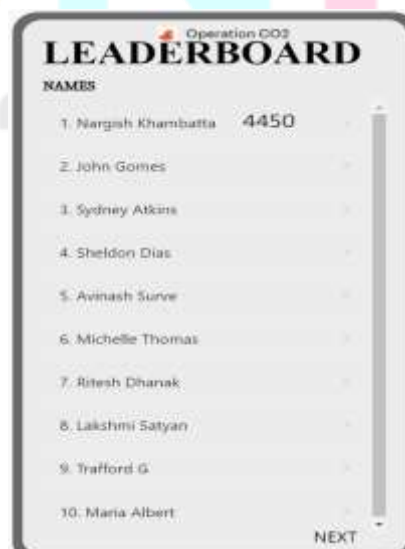


Figure 2: Leaderboard Screen

The 5 different categories under which eco-friendly activities can be performed are as follows.

- 1) Transportation: People can take public transportation or carpool with their friends to move about. A typical passenger vehicle emits approximately 4.6 tons of carbon dioxide each year. It will have a huge influence if individuals start carpooling or taking public transportation on a regular basis.
- 2) Household changes: From minor changes like using energy saving bulbs to major changes like installing solar panels for electricity, any household change will benefit the environment in the long run.
- 3) Environmentally related initiatives: Taking part in any environmentally related initiatives like paper collection, can collection.
- 4) Environment related drives: Hosting drives such as cleanup drives, recycling drives, waste collection drives etc. that will benefit the environment.
- 5) Bills: Water and electricity bill reduction or maintenance of low bills

3.2 Incentivization Within the App

The incentives provided to the users are divided into three categories: vouchers and prizes, government certification and social media recognition. The vouchers and prizes are intended to stem from the sponsors. Companies would want to sponsor this application as it provides them with both advertisement as well as green points and reduces their carbon footprint and adds to their environment responsibility (Corporate Environment Responsibility, falling under the branch of Corporate Social Responsibility). Government certification/awards can be provided by the government for helping reduce carbon footprint and for social service. The last branch of incentives, social media recognition, will include recognition on various social media platforms based on top contenders in the pool of participants. For this, the Operation CO₂ team will need to coordinate with the various bodies indicated above in order to form partnerships.

3.3 Impact of Operation CO₂

Thus, with the use of Operation CO₂ we are hoping that the following happens:

For the consumers(users): It helps establish healthy habits and promotes eco-friendly behavior among them and their families. They will be receiving awards and prizes for performing these activities while positively impacting the environment at the same time. Collecting evidence and getting rewards will also be an easier process.

For the environment: The amount of carbon emissions present will be significantly reduced. Every year in the UAE, 193.5 million tons of carbon dioxide is emitted [Statista,2023]. When these activities are performed by a large number of people on a regular basis, it will reduce immensely and help the country as a whole.

RESULTS AND DISCUSSION

4.1 Analyzing Second-Hand Data

Several studies have shown the positive effects of gamification on any target audience. In fact, gamification values in the markets are extremely high, reaching \$9.1 billion in 2020, and projecting.

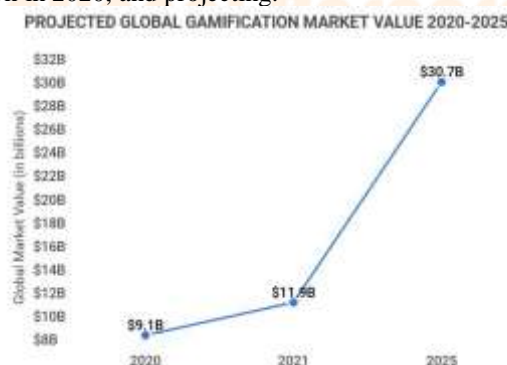


Figure 3: Graph showing growth in overall gamification market [1]

To reach \$30.7 billion by 2025 (Figure 3). 50% of startups are reportedly implementing gamification into their strategy, and the conversion rate of employees that use gamification is 700% [Chang, 2023]. Gamification proves to be effective in several ways. Studies show that there is an increase in customer engagement with the implementation of game mechanics into programs/applications. With regards to the environment, it is estimated that behavioral interventions could in fact drastically reduce carbon emissions by 20% from direct energy uses in households, which equates to around 120 million metric tons of carbon emission less than the entire carbon emissions of France in 2005 [Dietz et al., 2009]. Incentivization is a gamification method that focuses on rewarding the client for the activities they complete (in this case, environmentally friendly ones), thereby increasing the motivation and drive a person will have to perform these tasks. Despite the fact that there is no widely accepted definition of gamification and although no clear definition of gamification as an incentive for involvement exists in academia, it has been demonstrated that gamification plays a key influence in influencing consumer behavior for the better. [Aparicio, 2021]. Incentivization is a gamification strategy that has been widely incorporated into several different fields of business. The study of incentives, rewards and motivation is said to have started after psychologist B.F Skinner's research in the 1930's on operant conditioning. In his theory, Skinner describes the term positive reinforcement, wherein a behavior or response is strengthened by

incentives, the reward acting as a stimulus. The rewards provided and strategies that do ignite friendly competition, too, have been chosen based on facts. Furthermore, virtual game awards in games and as a showcase of one's accomplishments can provide users with pleasant psychological feedback. [Zhang, 2020]. Gamification statistics have proved that out of over 20 different types of game mechanics, 13% of people have chosen competing with their friends as their preferred method, and 27% of people have chosen getting points/scores as theirs [Chang, 2023]. Leaderboards are a type of game mechanic that creates the motivation for performing tasks and assists users in goal setting [Lounis, 2013]. Furthermore, the leaderboards in the application Operation CO₂ are used to ensure maximum outcomes and motivation.

4.2 Research from Primary Data

The data we got from a recent poll we ran on the influence of gamification and its incentivization on green behavior, with 100+ replies, reveals perfect outcomes of how these game mechanics work when it comes to environmental activities. The survey's average evaluation of the data received when respondents answered the question, "On a scale of 1 to 10, how much do you think the Earth has been impacted due to pollution and global warming?" was 8.48, with the highest number of responses people voting 10 and the lowest vote being 4, with one respondent voting for it. This reinforces our assumption that individuals are aware of the problem but are simply not acting on it. When asked whether they are part of any reward program, such as Shukran, Apparel, Smiles or Happiness, 66% of the respondents answered yes, indicating that most people are familiar with and respond well to the concept of incentivization. 74% of people answered yes when asked the question, "Would you be willing to perform any activity for a reward like points in return?" further strengthening this theory. Suggesting that this holds true for environment related activities as well, 81% of participants answered yes to the question, "Would you be willing to perform any environment related activity for a reward like points in return?" and 75% answered yes to the question "Do you think rewards would drive you to perform more sustainable and environment friendly activity?". When asked the question, "What sort of rewards motivated you to try gamification?", 24% of people answered extrinsic awards (external rewards such as praise, monetary, fame, etc.), 43% answered intrinsic awards (personal gains, self-motivated, etc.), and 33% answered rewards such as badges, certificates, leaderboards, etc. This suggests an overall balance with a slight bias towards intrinsic awards. Our app provides all three types, focusing more on the intrinsic awards as well. Indicating the fact that people in general respond well to gamification, 74% of respondents believe that gamification will make them more productive and enthusiastic, 74% agree and 13% strongly agree that gamification can help engage more people, 67% agree and 24% strongly agree that incentivization can make the process more rewarding and fun. 72% of people agree and 18% strongly agree that gamification can generate competitive spirit (in a healthy way), and 68% agree while 16% strongly agree that gamification can help improve productivity (Figure 4). With this in mind, the application Operation CO₂ focuses on incentivization as the main strategy of motivation for green behavior.

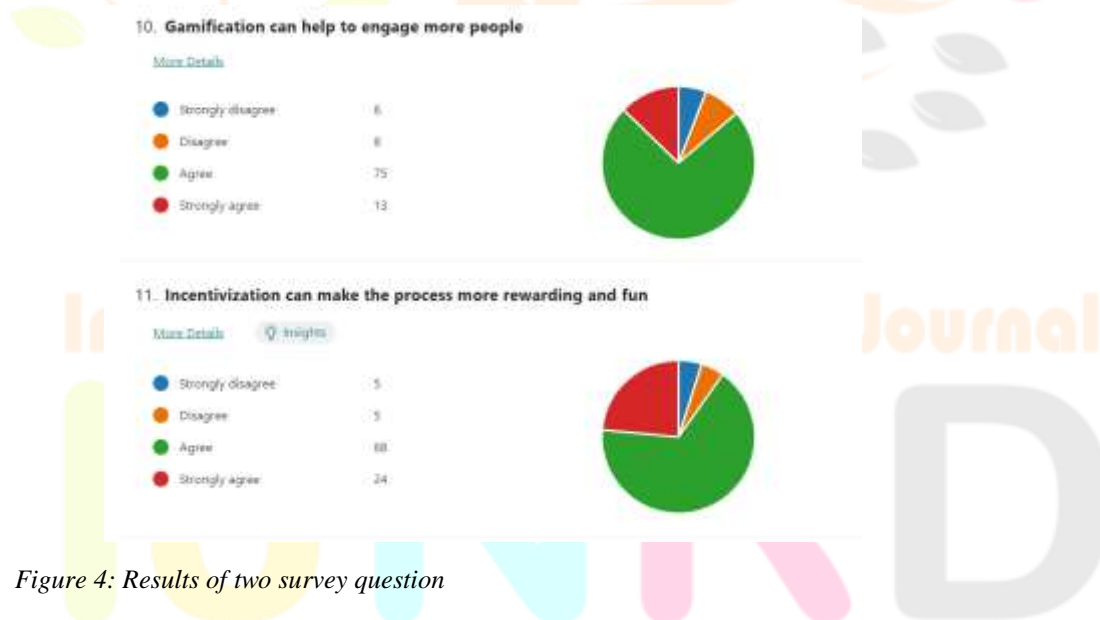


Figure 4: Results of two survey question

CONCLUSION

We can conclude from the research that gamification and incentivization will assist in increasing people's morale and give them the desire to achieve better and attain top rank for the rewards and their own happiness. We plan to apply the same strategies to encourage green behavior among individuals and communities especially young adults and children (and make rewarding for the same easier). The main reason for a large number of people not taking part in green behavior-based activities is due to lack of motivation and reason to do so. Operation CO₂ offers a wide variety of options for people to make the slightest changes and still be rewarded. This will hopefully make them feel happy and satisfied, and will make them want to do more for the Earth and for rewards. The app has been designed in line with the findings. The aim is to reach out to hundreds of thousands of people in the community and spread the word of awareness. Overall, we hope that the application helps in building an urge within people to help the environment using gamification and incentivization.

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